

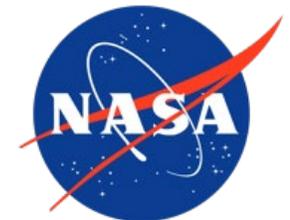
Mapping dry forest in two regions of Colombia using Landsat time series

Paulo Arévalo
Eric L. Bullock
Christoph Nolte
Ana Reboredo-Segovia.

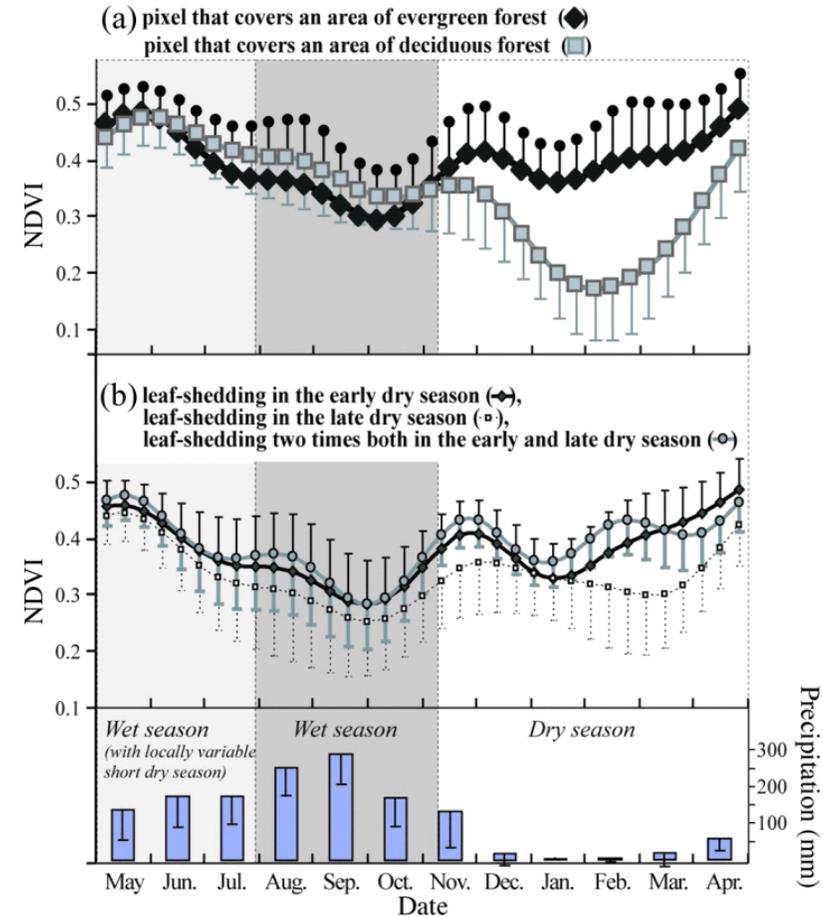
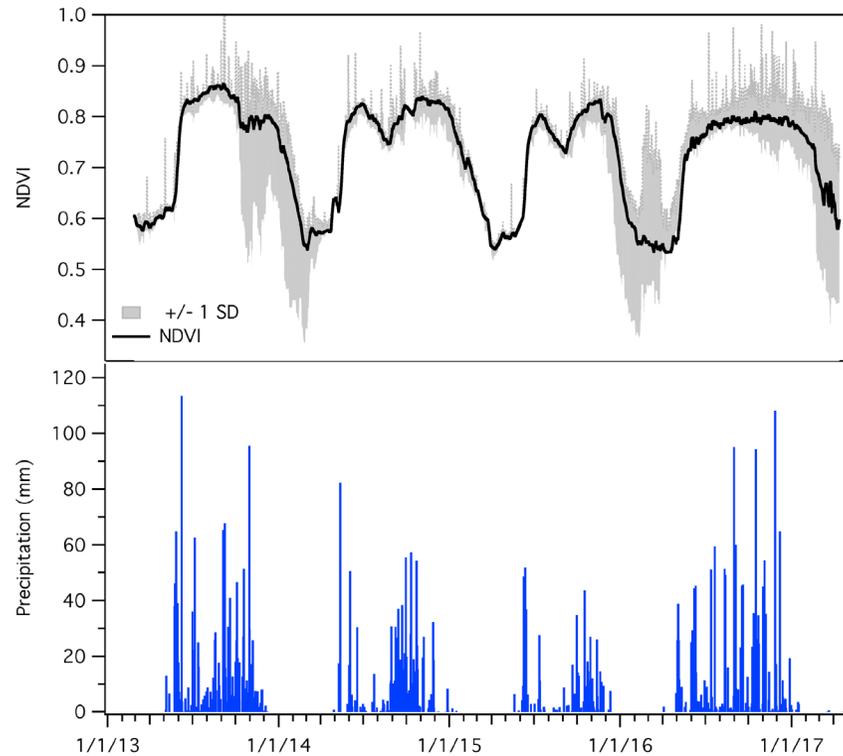
Collaborators:

José Camilo Fagua (National University of Colombia)
Roy González (Alexander von Humboldt Institute, Colombia)

Project: Comparing the effectiveness of conservation strategies in the Colombian Andes biodiversity hotspot



Tropical dry forest



Castro, S.M., Sanchez-Azofeifa, G.A., Sato, H., 2018. Effect of drought on productivity in a Costa Rican tropical dry forest. *Environ. Res. Lett.* 13, 045001. <https://doi.org/10.1088/1748-9326/aaacbc>

Ito, E., Araki, M., Tith, B., Pol, S., Trotter, C., Kanzaki, M., Ohta, S., 2008. Leaf-Shedding Phenology in Lowland Tropical Seasonal Forests of Cambodia as Estimated From NOAA Satellite Images. *IEEE Transactions on Geoscience and Remote Sensing* 46, 2867–2871. <https://doi.org/10.1109/TGRS.2008.919820>

Objectives

- Generate a training dataset representing the potential extent of dry forest in the Andean and Caribbean regions of Colombia.
- Generate multi-temporal maps of distribution of dry forest, using Landsat time series.

Methodology

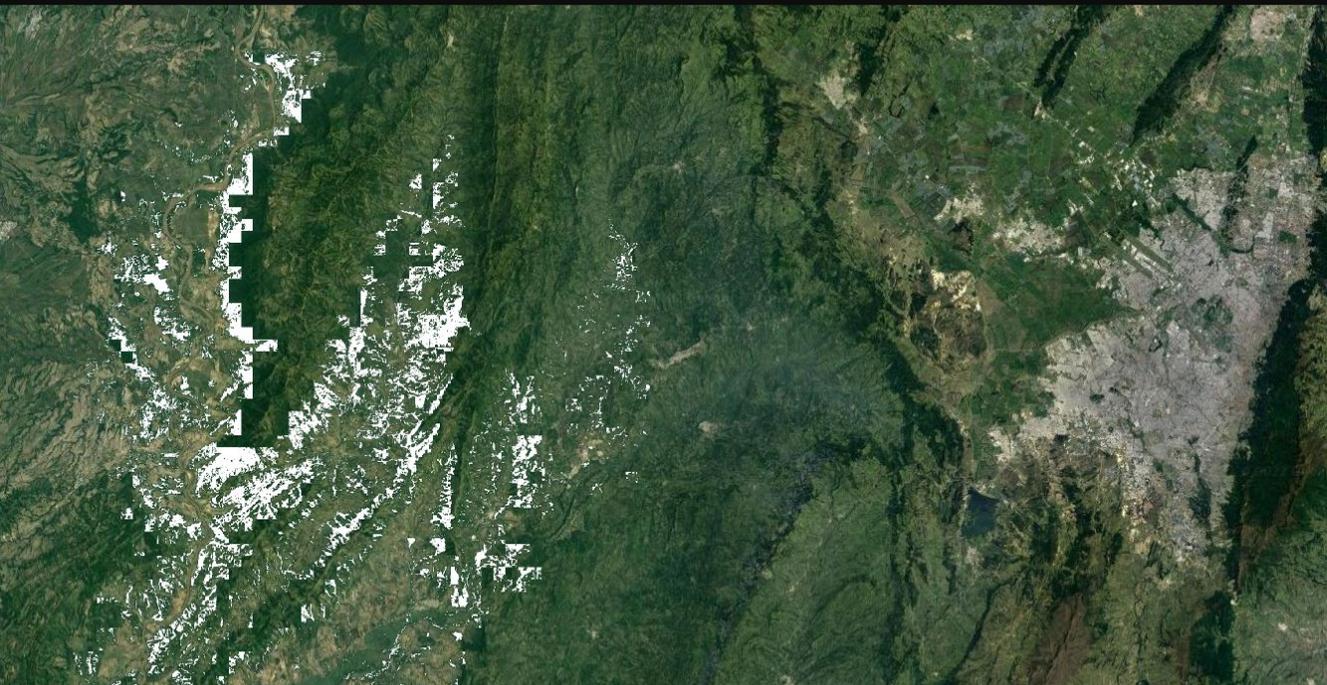
1. Generate envelope of potential extent of dry forest and non-dry forest.
2. Sample from the envelopes and merge with a non-forest training dataset
3. Train a random forest model using predictors from Landsat time series

Generating a mask of potential dry forest extent

Variable	Dry Andes	Non-Dry Andes	Dry Caribe	Non-dry Caribe	Non Forest
Annual mean temp (bio1)	> Q4	< Q4	> 25 C	< 25 C	-
Annual precip (bio12)	< Q1	> Q3	< 2000	> 2000	-
Precip. Driest month (bio14)	< Q1	> Q3	-	-	-
Precip. Driest quarter (bio17)	< Q1	> Q3	< 110	> 110	-
Elevation (SRTM 30 m)	< Q1	> Q1	< 1000	> 1000	-
Mean PET (MODIS 500 m)	> MEAN	-	> Q4	-	-
Max PET (MODIS 500 m)	-	-	> Q4	-	-
Sample size	1000	1000	1000	1000	2000



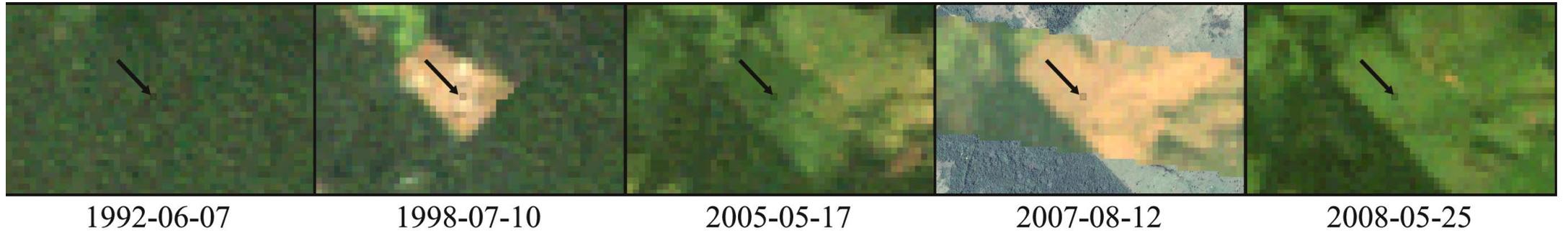
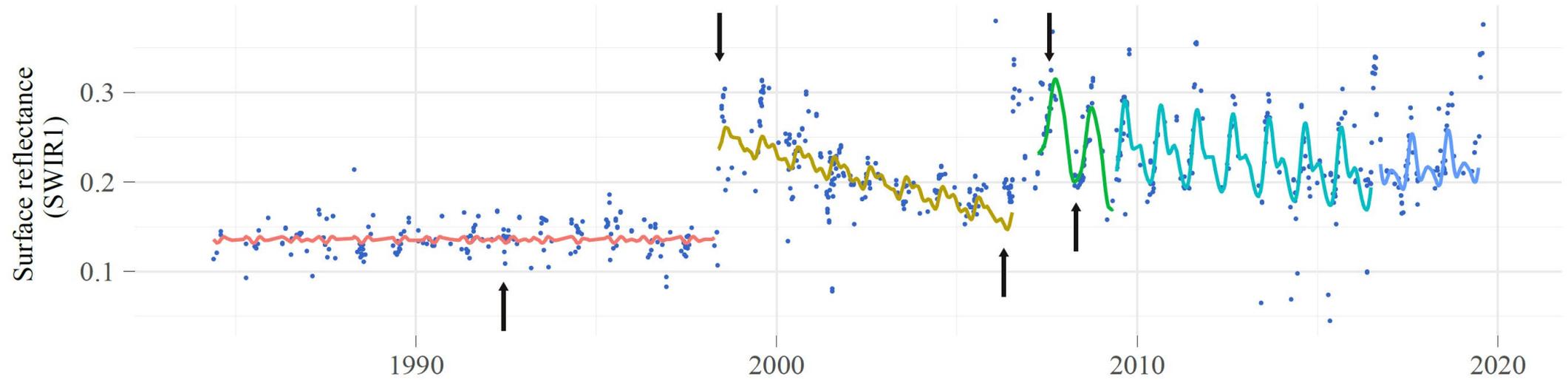
Zoom-in to the potential dry forest envelope in the North Andes/Caribbean region

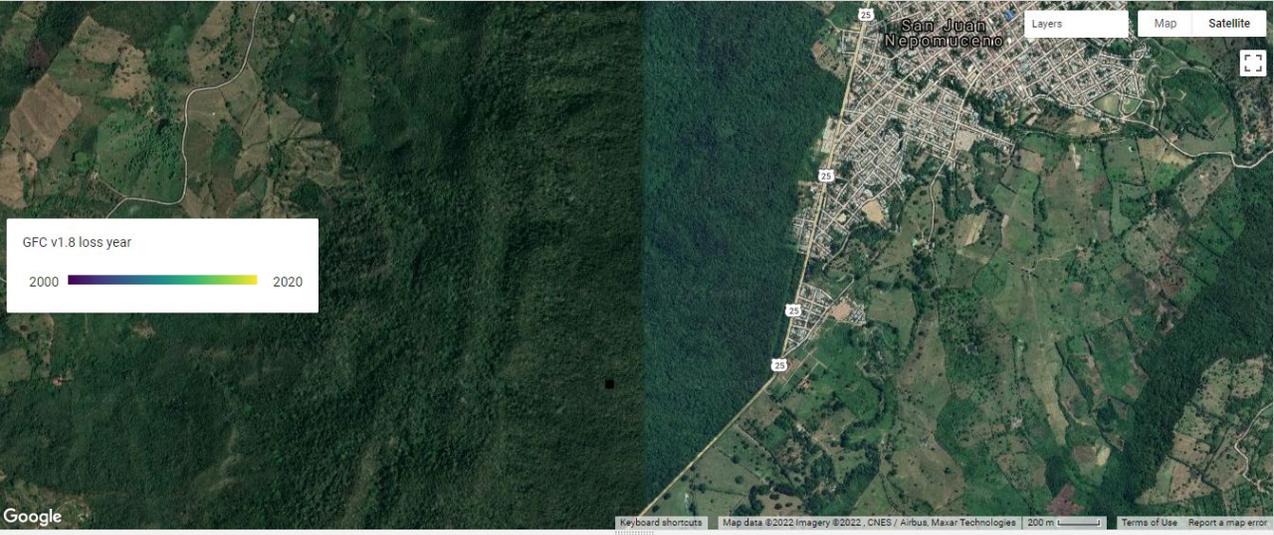
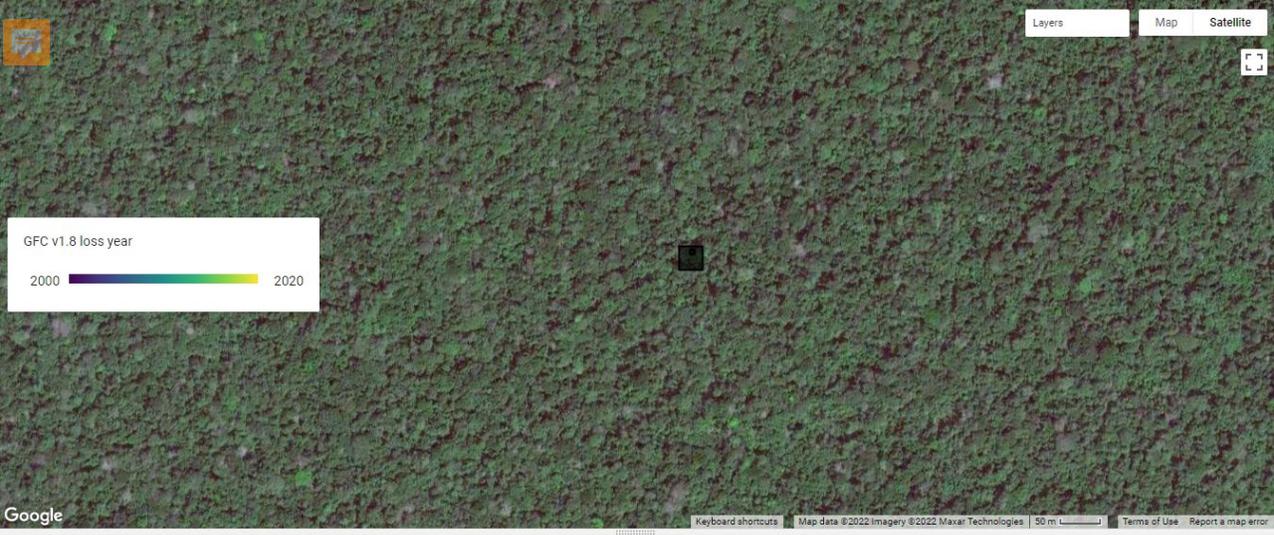


Zoom-in to the potential dry forest envelope in the Magdalena valley

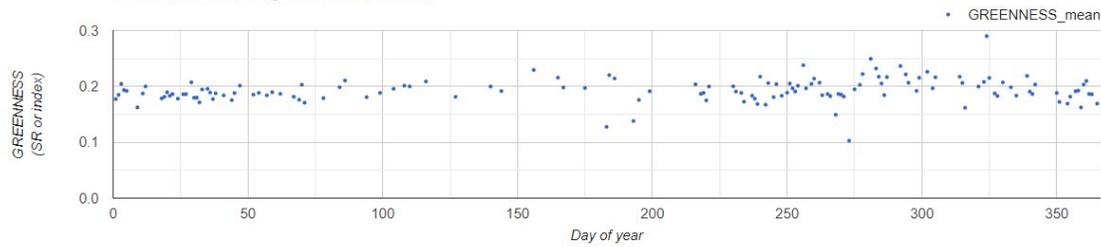


CCDC: continuous change detection and classification

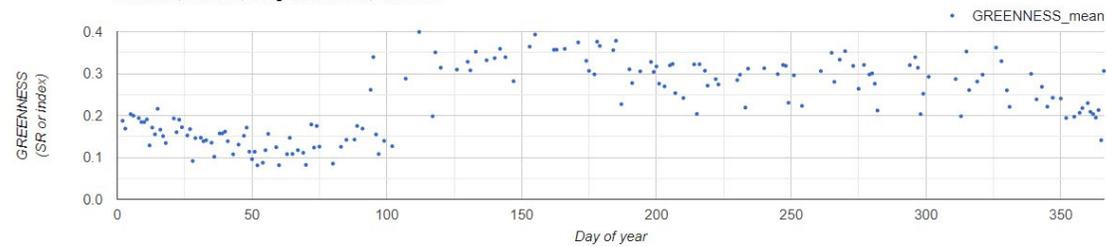




DOY Plot, Latitude, Longitude: 1.1096, -72.0057



DOY Plot, Latitude, Longitude: 9.9354, -75.0990



Humid forest in the Amazon

Dry forest in the Caribe region

Seasonal GREENNESS

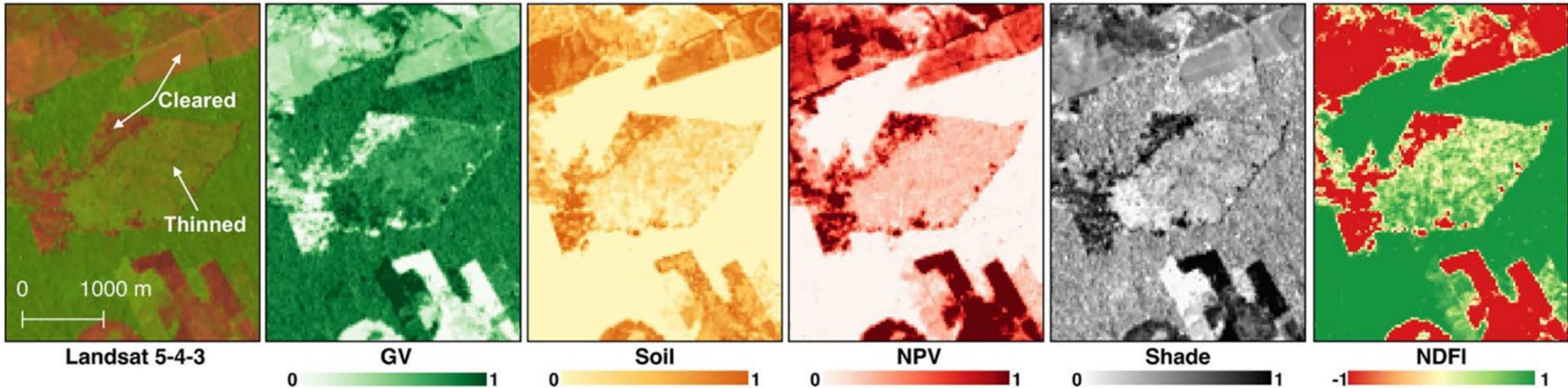
Seasonal GREENNESS



TYPE	NAME	COEFFICIENTS AND CCDC DERIVATES
SPECTRAL	GREEN RED NIR SWIR1 SWIR2	INTP SLP PHASE, PHASE2 AMPLITUDE, AMPLITUDE2 RMSE SYNT
INDEX OR TRANSFORM	NDFI GREENNESS BRIGHTNESS WETNESS	
SPECTRAL UNMIXING COMPONENTS	Shade NPV Soil	
OTHER VARIABLES	ASPECT DEM_SLOPE	-

1. Extract predictors for the entire training dataset (6K)
2. Generation of annual maps of probability of three classes: dry forest, non-dry forest and non forest.

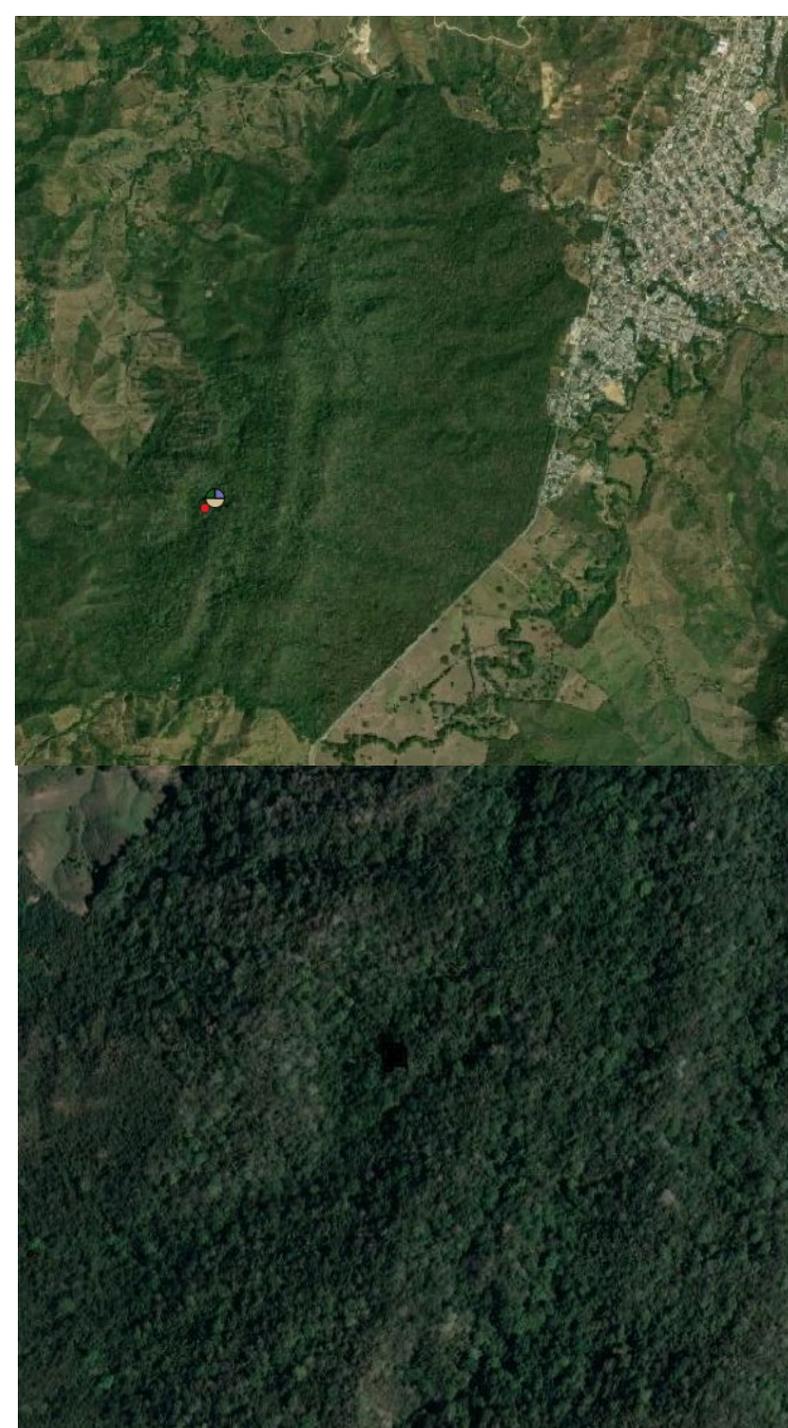
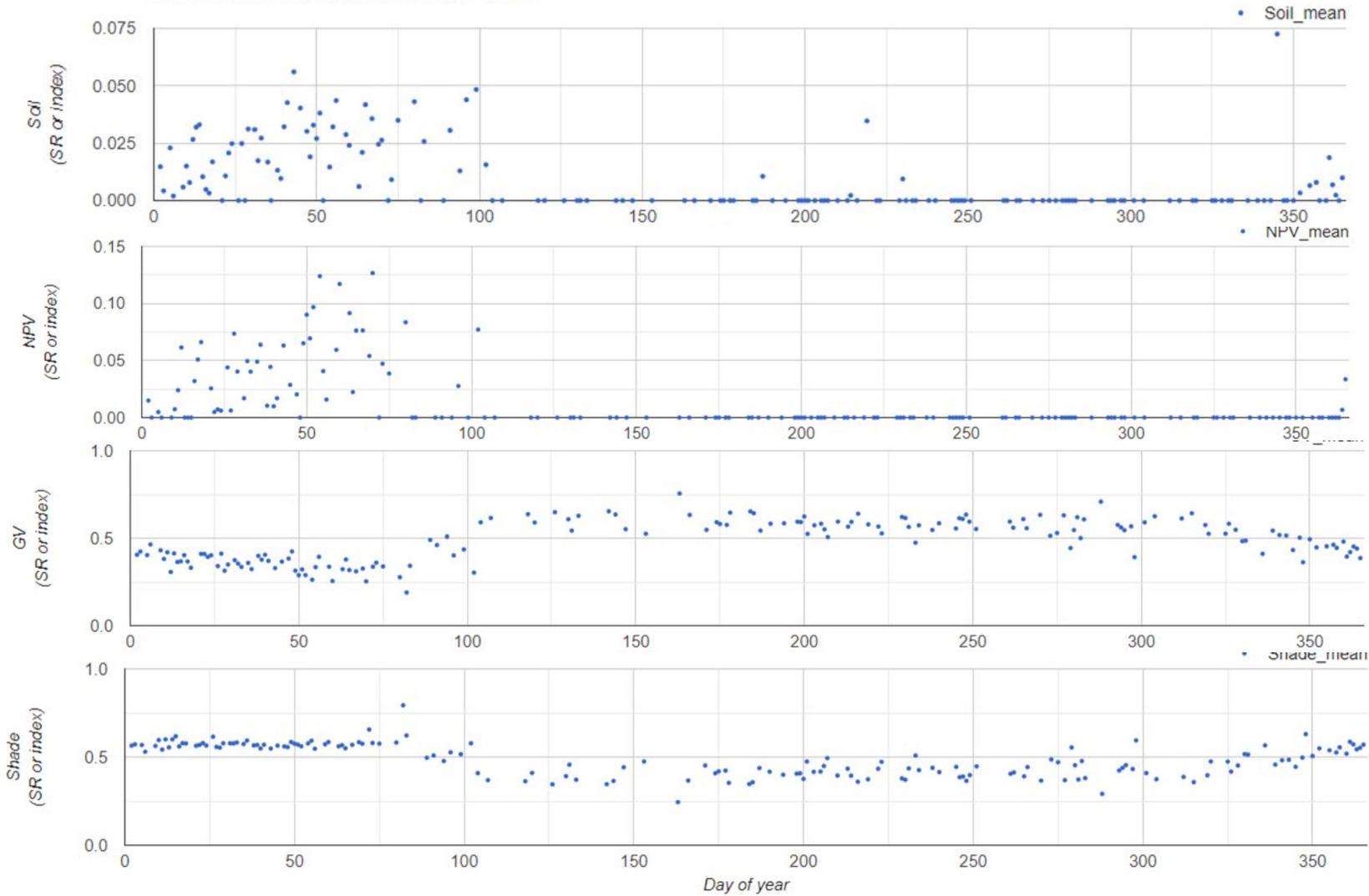
Spectral unmixing

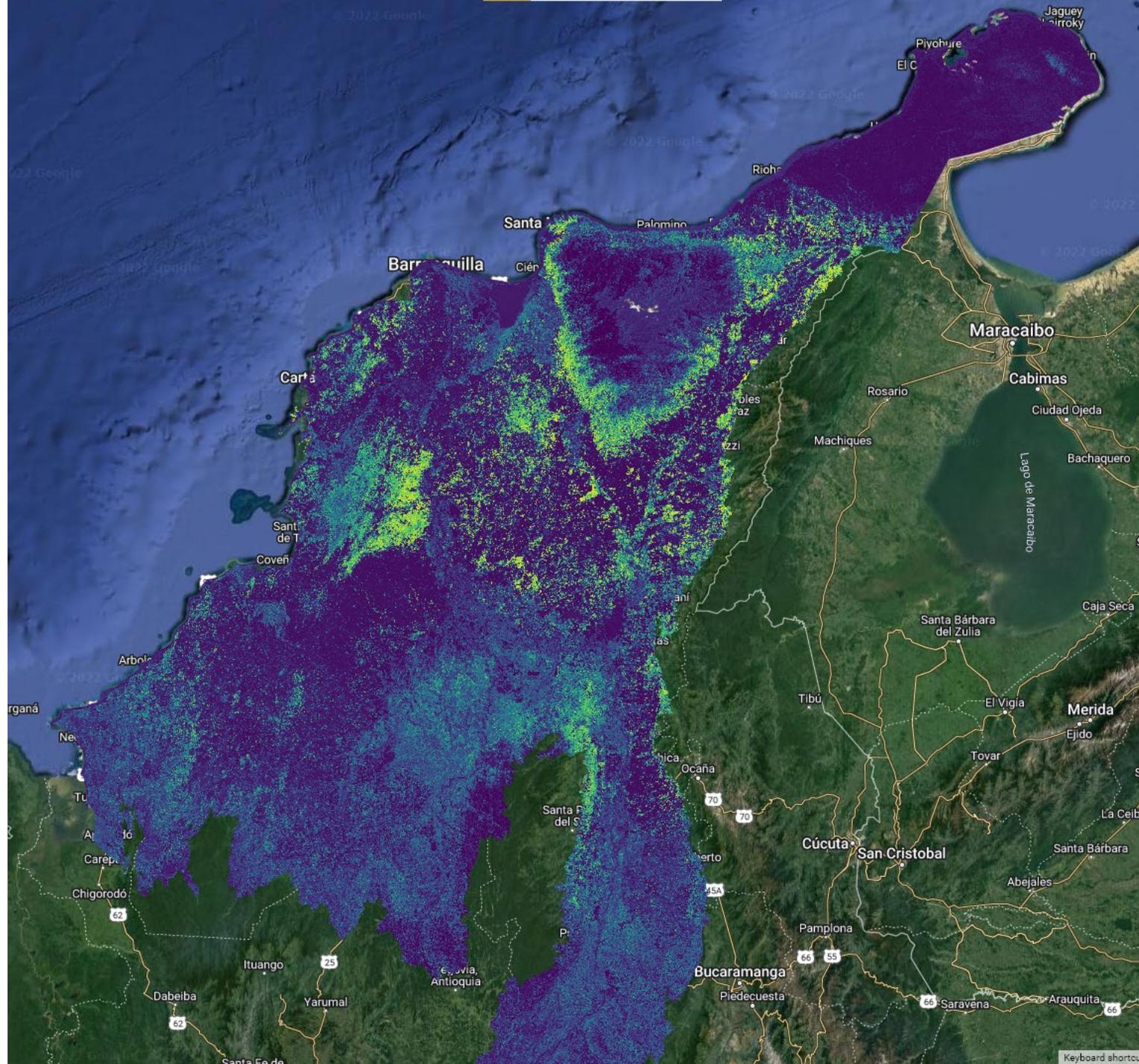


C.M. Souza, D.A. Roberts, M.A. Cochrane. **Combining spectral and spatial information to map canopy damage from selective logging and forest fires.** *Remote Sens. Environ.*, 98 (2005), pp. 329-343, [10.1016/j.rse.2005.07.013](https://doi.org/10.1016/j.rse.2005.07.013)

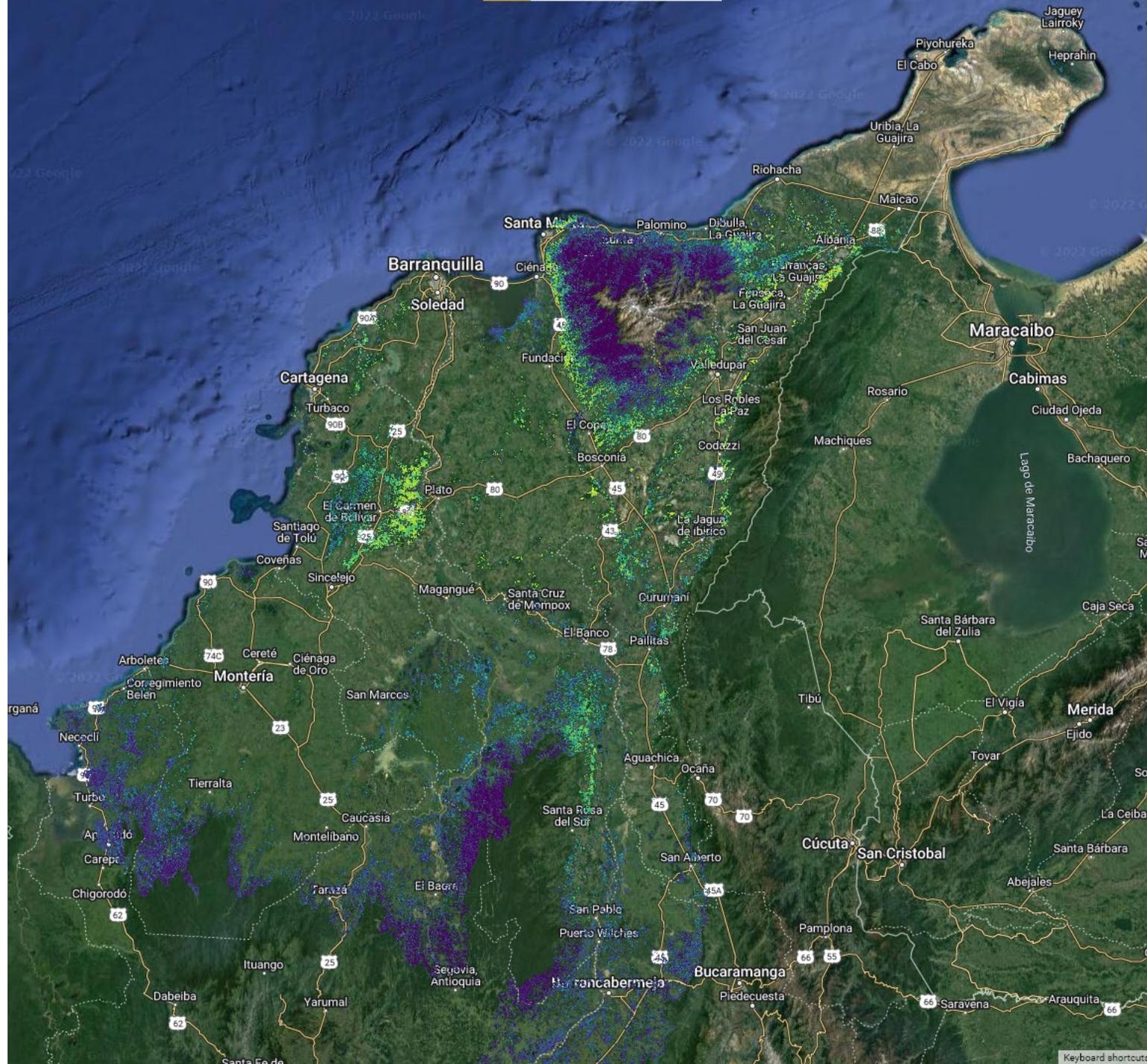
E.L. Bullock, C.E. Woodcock, P. Olofsson. **Monitoring tropical forest degradation using spectral unmixing and Landsat time series analysis.** *Remote Sens. Environ.*, 110968 (2018), [10.1016/J.RSE.2018.11.011](https://doi.org/10.1016/J.RSE.2018.11.011)

DOY Plot, Latitude, Longitude: 9.9365, -75.1097

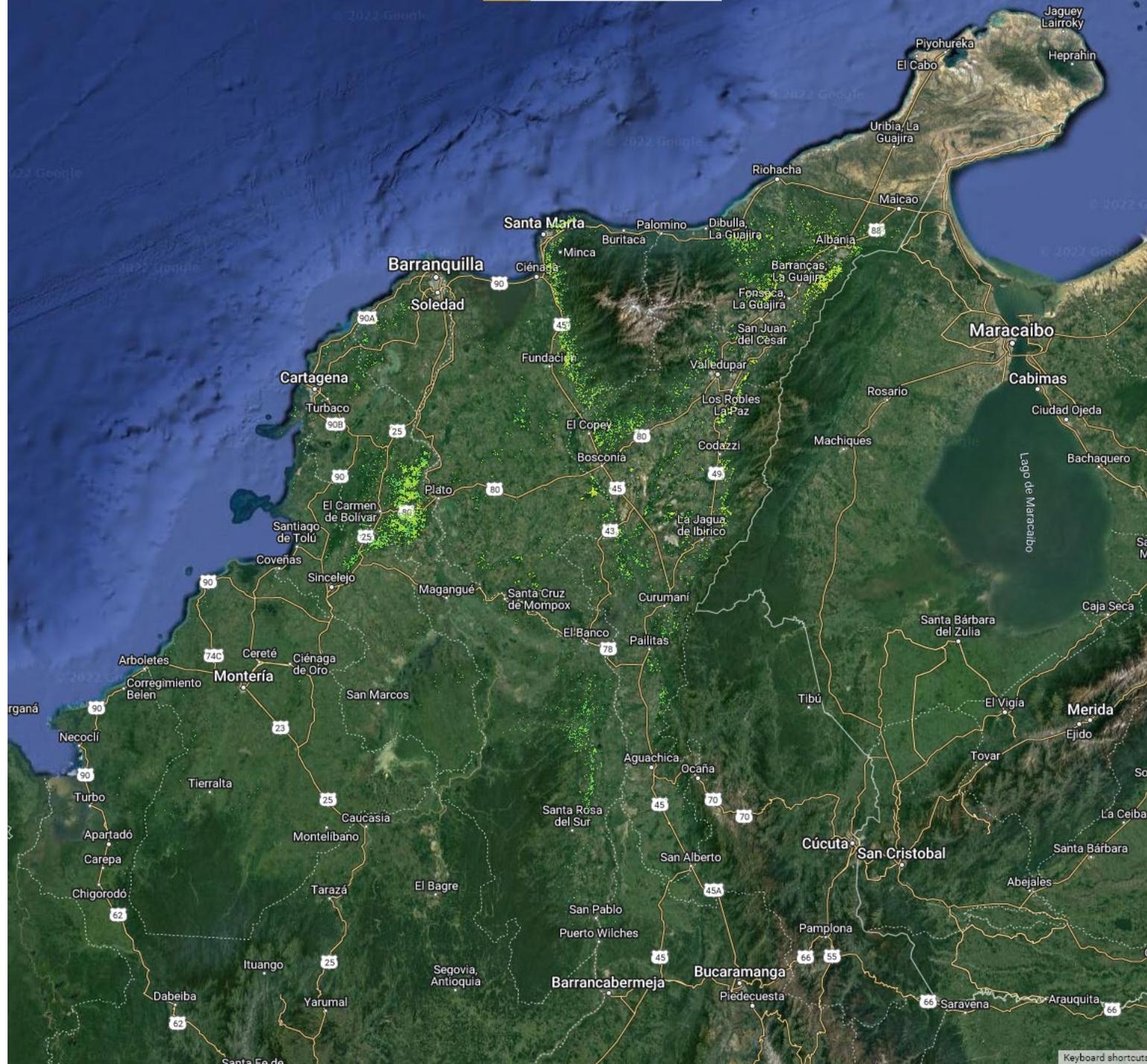




Caribe
Dry forest
probability



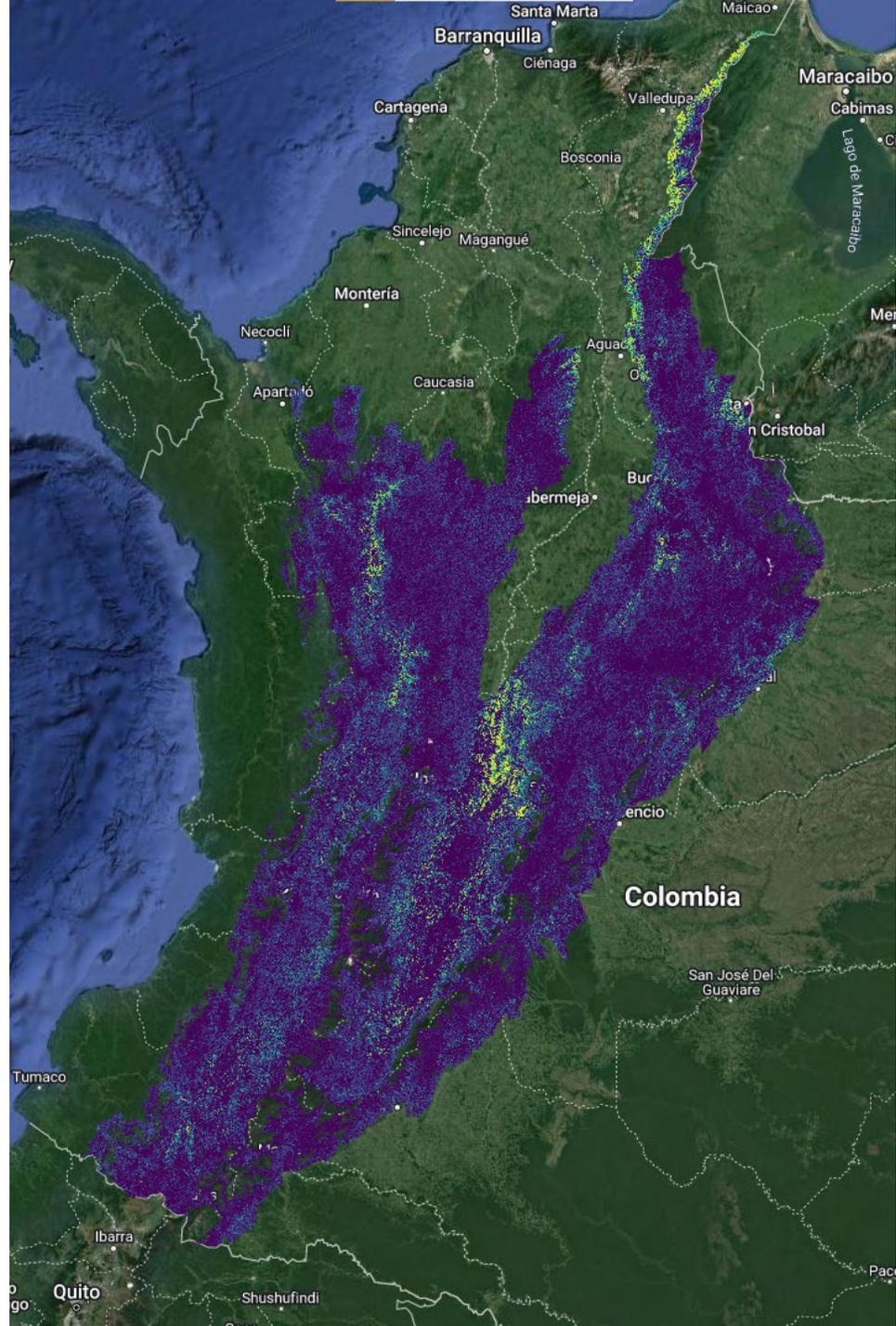
Caribe
Dry forest prob.
Forest only



Caribe

Dry forest prob > 0.7

Forest only



Andes
Dry forest
probability



Andes

Dry forest prob.

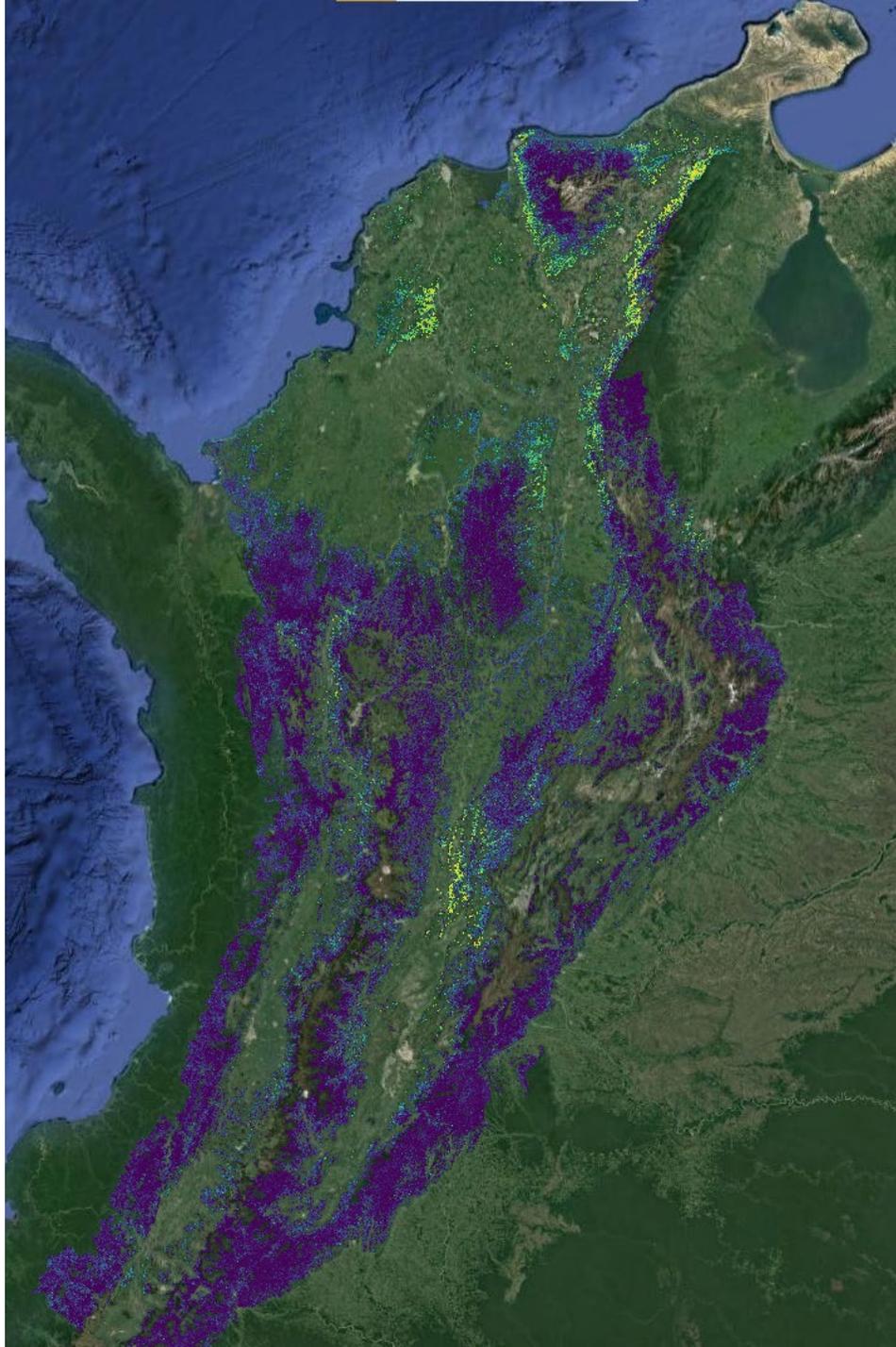
Forest only



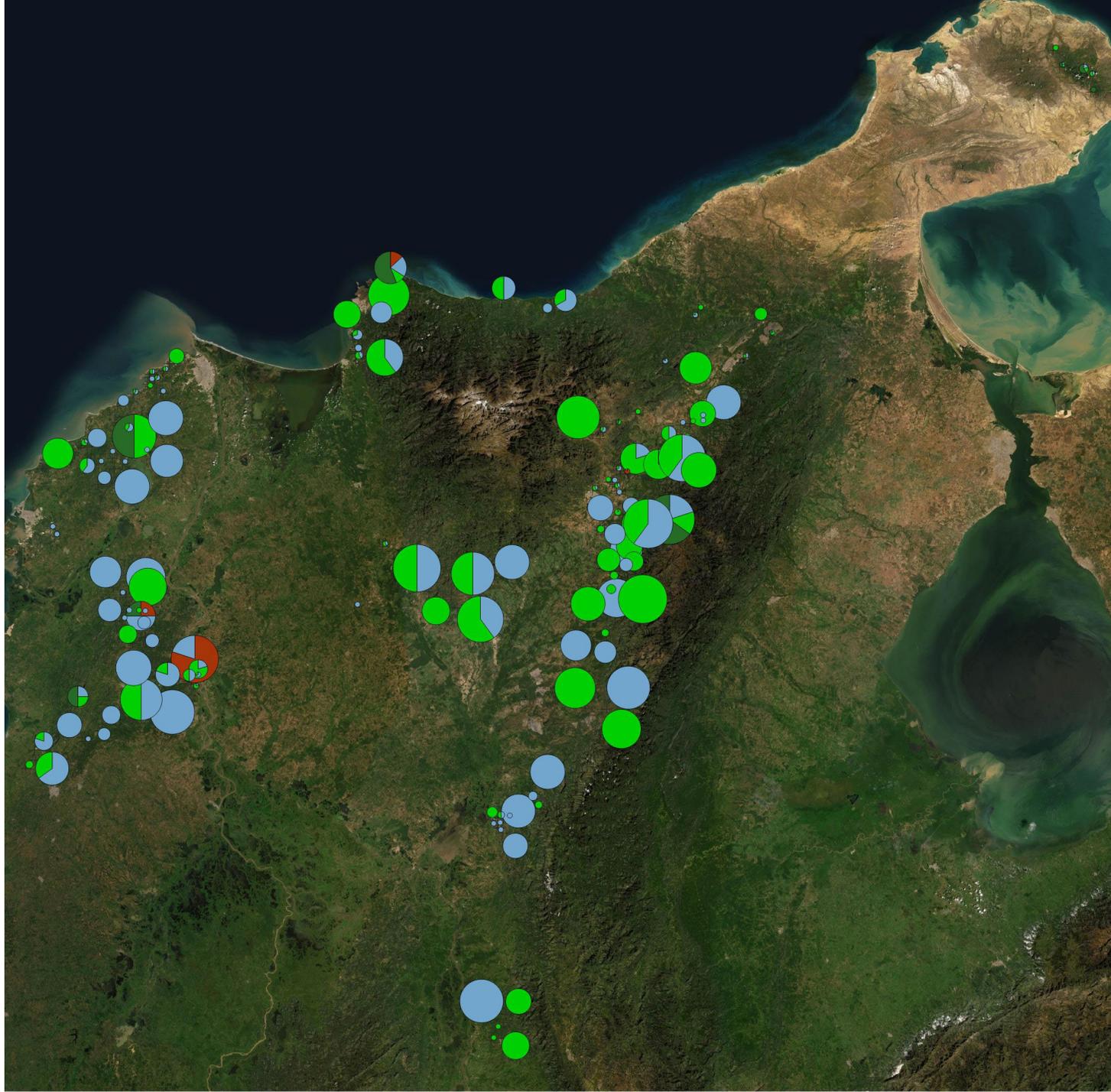
Andes

Dry forest prob. > 0.7

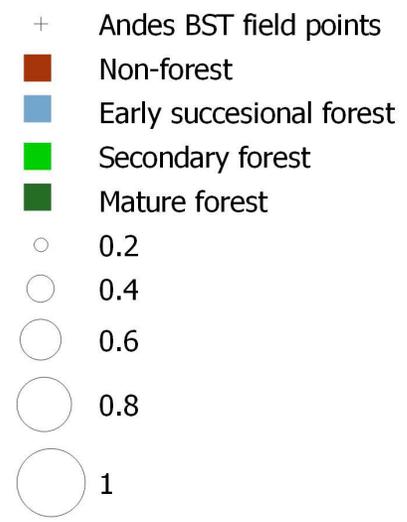
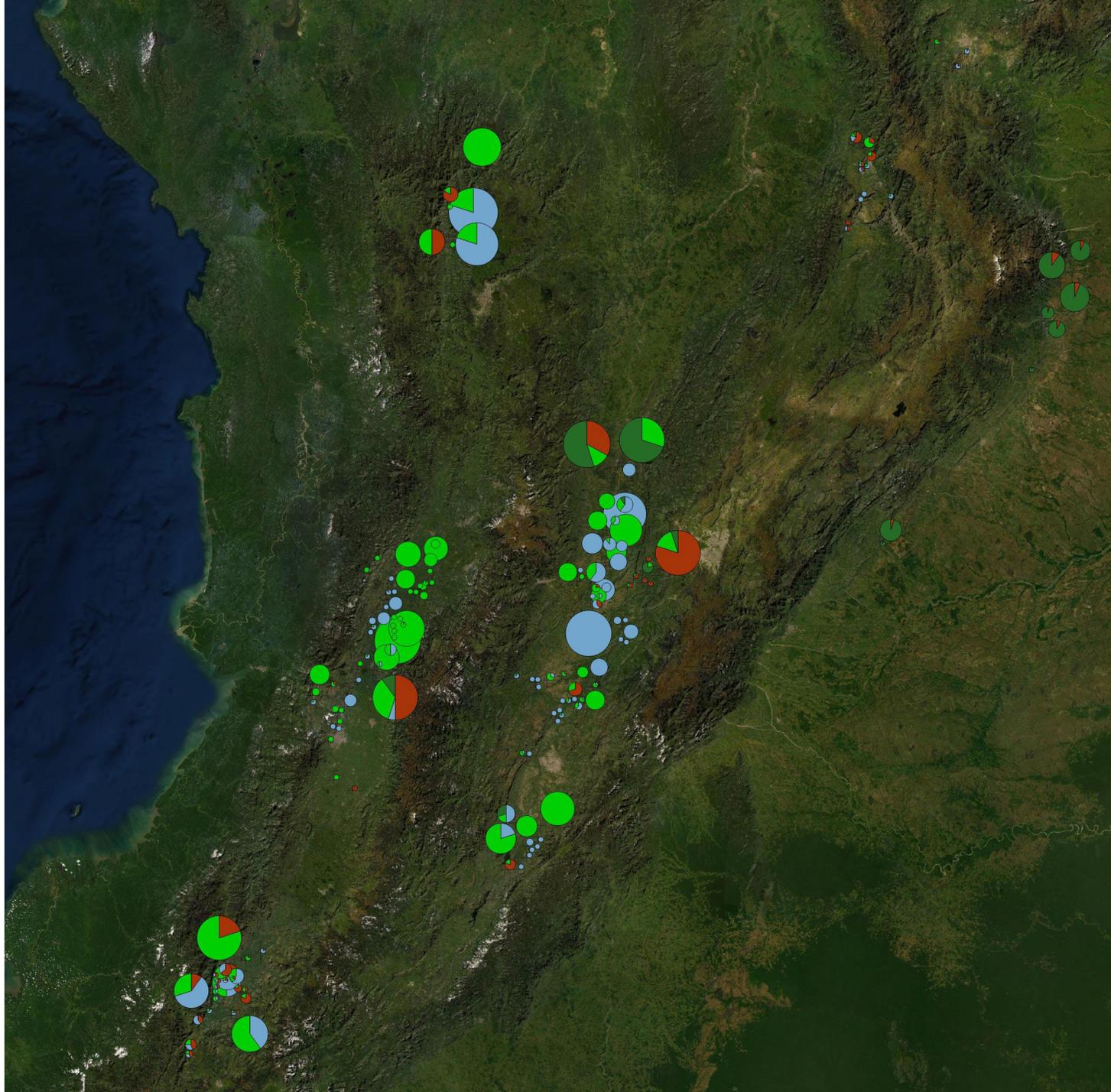
Forest only



Probability of presence of dry forest, after masking non-forest areas



- + Caribe BST field points (2014)
- Non-forest
- Early succesional forest
- Secondary forest
- Mature forest
- 0.2
- 0.4
- 0.6
- 0.8
- 1



Conclusions and next steps

- Spectral-temporal features from Landsat are useful to distinguish tropical dry forest from humid forest in the Andean and Caribbean regions in Colombian.
- Field locations need to be matched carefully with closest adjacent forest pixels to calculate accuracy properly.
- Assess change in dry forest over time.
- Evaluate if distinguishing different types of dry forest is possible.